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# THE FIRST CHINESE STUDENT SPACE SHUTTLE GETAWAY SPECIAL PROGRAM

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## Abstract

The first Chinese Getaway Special program, including program organization, student proposal evaluation procedure, contents of some of the finalists' experiments, will be presented. Specifically, the two experiments selected for the eventual flight on the Space Shuttle will be described in detail.

## 1.0 The Chinese GAS Program

The first Chinese student US space shuttle getaway special (GAS) program was jointly organized and sponsored by American Association for Promotion of Science in China (AAPSC), a Los Angeles-based nonprofit organization, and Chinese Society of Astronautics (CSA), based in Beijing, China. The agreement was signed on December 27, 1985 in Beijing, China. The call for proposals from vast population of Chinese secondary school students, estimated at 150 millions strong, was announced in January 1986. Over seven thousand proposals were submitted before the end of summer, in spite of the demoralization caused by the Challenger disaster. Those proposals were evaluated by a two-tier process. First, the proposals were presented and defended orally by student proposers at nine regional locales approximately evenly distributed throughout China. Those regional symposia, actively participated by six experts from the States and many of their Chinese counterparts, produced a total of 264 regional proposals for further consideration in the national symposium to be held during the Christmas season of 1986, in Beijing, China. The national proposal

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evaluation committee consisted of seven American and twenty-five Chinese experts whose specialties covered a broad range of space science and technology disciplines.

The criteria that they had applied uniformly throughout the entire selection process were based on the proposal creativity, scientific merits, experiment feasibility and organization. The committee certainly went through quite a difficult time in deciding what to accept or decline. Nevertheless, twenty proposals were selected as the national finalists. Those proposals, as well as those not chosen, were generally of surprisingly good quality considering the severe handicap that the Chinese students must cope in search for information needed for the research topic. The titles for those twenty proposals are:

1. Control of debris in the cabin of space shuttle, by Wang Nian-qing
2. Solidification of two immiscible liquids in space, by Tian Chun-Liang
3. Effect of cosmic ray on pharmaceutical products, by Shi Gang
4. Effect of μg on plant cell reproduction, by Zhao Quan-Zhong
5. Effect of μg on onion cell reproduction, by Tian Yu-Zhi
6. Application of Velcro in space, by Wang Hai-jiang
7. Observation of surface tension under μg, by Zhou Yan
8. Effect of μg on germinatn of Chinese herb seeds, by Huang Zheng-Chong
9. Ice formation at different temperatures under μg, by Liu Zhong
10. Healing worm injury under μg, by He Kai
11. Mixing paraffin, water and ice under μg, by Zhu Lei
12. Speeding up chemical reactions under μg, by Huang Wen-Ge
13. Gas and liquid phase separation under μg, by Liu Shu-Xiang
14. Coating and capillary absorption under μg, by He Bin
15. Making Tofu in space, by Zhan Han-Jing
16. Behavior of NaCl solution droplet in E field under μg, by Song Yang
17. Property of liquid crystal under μg, by Zhang Jin-Song
18. Effect of μg on Chinese painting, by Zhang Qin-Mei
19. Effect of μg on germintn./reprod. of Chinese mushroom, by Shen Zhong
20. Feathered Ying-luo plant growth in space, by Jiang Yong-Bo

The first two(#1 and 2) experiments were further designated, after hours of heated debate among committee members and final settlement with a secret balloting, as the first Chinese student microgravity payload for a future US space shuttle flight. The third proposal was selected as the back-up. The hardwares for carrying out the GAS experiments are in the process of being developed and fabricated by Beijing Institute of

Environment Test Engineering(BIETE). The qualification for flight in space shuttle is scheduled to complete in the second quarter of 1988.

To commemorate this event, a logo has been designed (Fig. 1). The lone star in the sky of the Great Wall signifies that it is the first such event in China.

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Figure 1. The logo to commemorate the Chinese student space shuttle getaway special program. The lone star in the sky of the Great Wall signifies the first such event in China.

## 2.0 Student Experiments

Experiment 1: **"The control of debris in the cabin of space shuttle,"** by Wang Nian-Qing

The purpose of the experiment is to study the motion of debris (small particulates) in the cabin of shuttle under the microgravity condition. A certain amount of simulated particulated debris are stored in a container, a side wall of which is covered with a sheet of adhesive paper. A movie camera will be mounted in the container to photograph the motion of debris upon their release in the microgravity environment and to record the moment when they make contact with the side wall and are captured. From a practical point of view, this simple technique could be applied to remove floating particulates from the living environment in space. In addition, the particulates rely on the residual gravity to initiate the movement. The mathmatical modelling of the experiment could be related to the pseudo-random walk problem. It is highly probable that the residual magnitude of the gravitational field on the shuttle can be backed out from the statistical measurement of those particulate movements.

Experiment 2: **"The solidification of two immiscible liquids in space"** by Tian Chun-Liang

Two immiscible low melt-point materials (Wood's metal and paraffin) will be premixed in various ratios and manners in the solid form on earth and remelted in space, then left to cool and resolidify. It is predicted that paraffin and Wood's metal be phase separated and assume amorphous and crystalline structures, respectively. Depending on the magnitude of the residual gravitational field in the shuttle, the two phases may be uniformly mixed or droplets of the same species may coalesce to form large conglomerates due to the nature tendency for a physical system to minimize its total internal free energy. The samples are to be post-flight analyzed.

## 3.0 Experimental Apparatus

3.1 Size and weight of the payload: 2.5 cubic feet, 60 pounds.

3.2 Experiment description:

Experiment 1: In this experiment 25 small lumps of different materials to be used as "space debris" or "particulates" will be stored in a container. A side wall will be coated with adhesive cloth. An 8 millimeter movie camera will be installed to view the adhesive wall, to photograph the motion of those small bits of debris after being released under microgravity conditions, and to record the moment when they make contact with the wall. It is desired that every collision of a particulate with the adhesive wall will result in a capture by the wall. However, this is not a prerequisite for the success of the experiment. The camera will be controlled and pictures will be taken at a preprogrammed time sequence. The container will be maintained intact for further post-flight analyses.

Experiment 2: 8 small cylindrical containers, each 2 cm in diameter and 6 cm in height, will be loaded with paraffin and Wood's metal mixtures in

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different ratios and manners. The two heaters are of foil-type, each powers 4 cylinders. The heating and cooling sequence are preprogrammed. Those containers will be left intact after the space experimentation so that they can be post-flight analyzed.

### 3.3 Supporting Structure

To provide added thermal insulation, the entire experimental apparatus will be housed in foam/fiberglass composite shells within the GAS canister. These hexagonal type structures are the same as the "spacepak" used in the similar payload in the past GAS flights. Experiment #1 will be stacked on top of the Experiment 2 in a two-spacepak configuration.

The spacepaks will be held by three sets of aluminum ribs on the exterior. At one end of the rib assembly is an aluminum ring with bolt holes for securement to the experiment mounting plate. At the opposite end of the rib assembly, there are three separate bumpers to provide lateral support of the payload within the container.

Figures 2 and 3 show the top view of those two experiments. Each

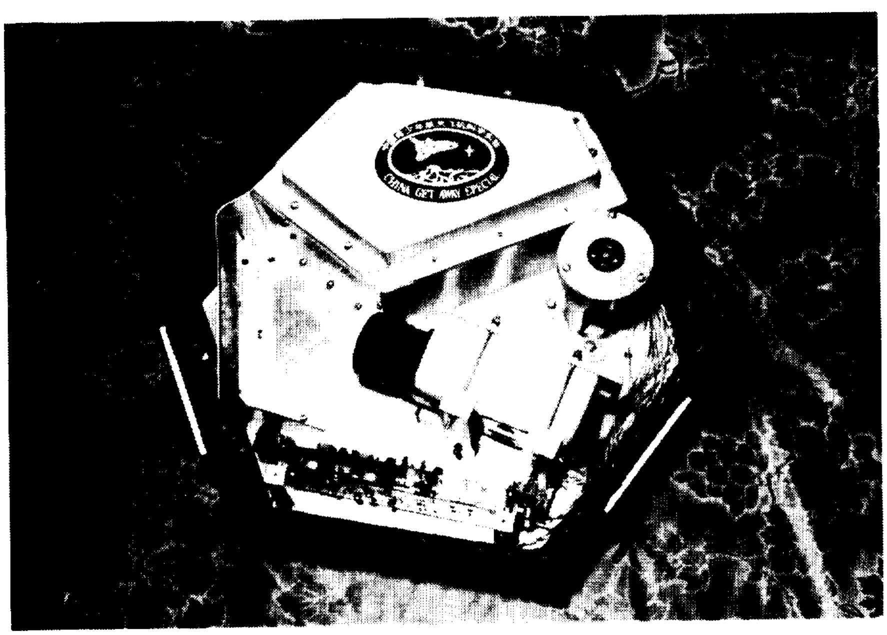

Figure 2. Top view for experiment #1. Initially, the debris are confined inside the right half of the chamber (marked by the logo) by a partition to slide open in the orbit.

experiment has its own controller and power supply. All batteries are installed in the second spacepak.

3.4 Controllers and Power Supplies

Two controllers, one per spacepak, are used to sequence various functions to be performed in the experiments and to record data from analog sensors. It is 65Co2-based microcomputer with 8K RAM, 16K ROM and 32K EPROM. All the programs and all the data collected are stored in EPROM. This same type of controller has been used in several previous GAS payloads of the Utah State University by Professor Rex Megill and his students.

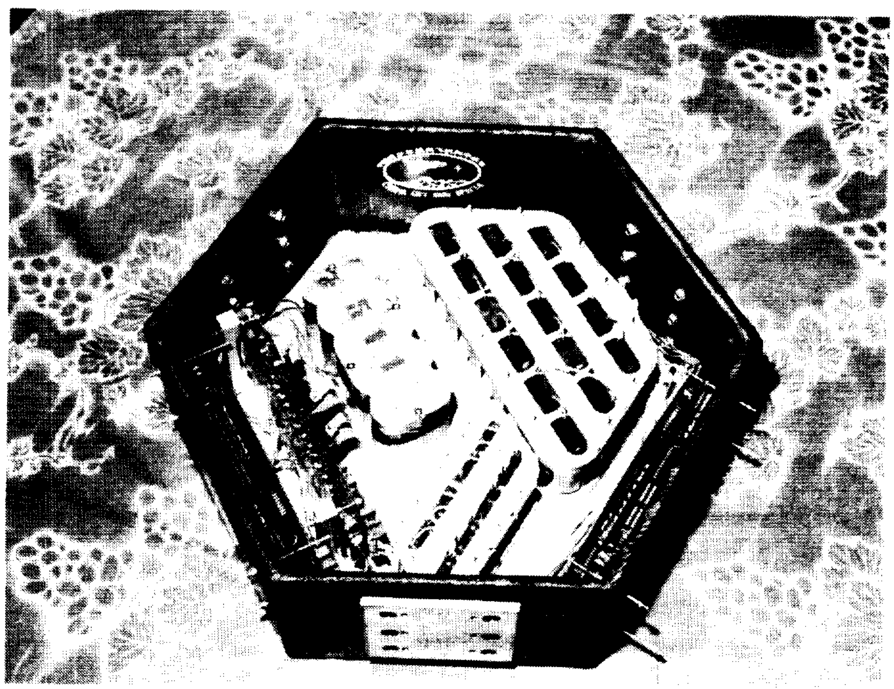

Figure 3. View for experiment #2. Eight small cylinders containing solid mixtures of paraffin and Wood's metal in different ratios and manners are installed under the cover marked by the number 511.

Each spacepak will have two separate power supplies to power the controller and to operate all other electrical devices in the spacepak, including all electronic interface circuitries to the controller. The batteries to be used are rechargeable lead-acid Gates X-cells or D-cells wired in series.

### 3.5 Operational Scenario

After the shuttle enters the orbit, relay "A" will be turned on at 70,000 feet by a baroswitch automatically. This action sends power to the controller which initiates the controller program sequencing. The controller will wait 2 hours before activating any of the devices in the payload.

In experiment 1, the controller will activate the torque motor to strip off the protective film from the adhesive wall, then the debris will be released and photographed at predetermined time intervals. In experiment 2, the controller will switch on the heater circuits, monitor temperatures and switch them off when the temperature reaches the predetermind value.

## 4.0 Development of the Payload

### 4.1 Preliminary Design Phase

Both Wang Nian-Qing and Tian Chung-Liang participated actively in the preliminary design phase of their experiments. During the same time period, they have carried out, thanks to the assistance of the scientists and engineers at BIETE, many ground-based preparatory experiments. Those experiments included: heating and melting the mixture of Wood's metal and paraffin by battery power; taking pictures of debris in order to determine the clarity and resolution of the photography; performing test for selected adhesives, etc.. Data collected from those tests helped to guide the design and fabrication of the engineering prototype for the flight model.

### 4.2 Flight Model Manufacturing Phase

After numerous modifications and iterations of the engineering prototype, the flight model of the payload has been designed and is being fabricated, which includes:

(1) The spacepak and supporting structures for camera, motor and batteries , etc;

(2) The control system, including printed circuit boards and software;

(3) Foil-type heaters and cylindrical containers;

(4) Assembling;

4.3 Environmental Testing

According to the requirements of experimenter's handbook for GAS payload, environmental testings such as vibration and vacuum thermal test are to be performed on the flight model to demonstrate its compatibility with the space shuttle environments. These tests are in progress and will be completed upon the approval of the phase III Safety Data Package from NASA.

## 5.0 Acknowledgement

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